The following summaries are provided for research published and presented from January 2015 through December 2016, and is provided as a supplement to the Clinical Research Summary dated September 2015. We utilized the PubMed database, with search terms “AlterG”, “lower body positive pressure treadmill”, and “antigravity treadmill”. Due to the large expansion of the number of installed AlterG Treadmills worldwide, many independently produced studies are proceeding without the knowledge of our company and we recognize that the search results may not fully represent the breadth of ongoing research. We encourage researchers to make us aware of concluded studies for inclusion in future Research Summaries.

Abstracts are included for selected publications. *Editorial commentary is printed in italics, and marked as “Commentary”.*

The reader is advised to consult the source documents for detail on each study.
ORTHOPAEDIC SURGERY: KNEE OSTEOARTHRITIS


- Although obesity is associated with osteoarthritis, it is unclear whether body weight (BW) independently affects articular cartilage catabolism (i.e., independent from physiological factors that also accompany obesity). The primary purpose of this study was to evaluate the independent effect of BW on articular cartilage catabolism associated with walking. Twelve able-bodied subjects walked for 30 minutes on a lower-body positive pressure treadmill during three sessions: control (unadjusted BW), +40%BW, and -40%BW. Serum cartilage oligomeric matrix protein (COMP) was measured immediately before (baseline) and after; and 15 and 30 minutes after the walk. Compared to baseline levels, walking with +40% body weight and normal body weight both elicited significant increases in articular cartilage catabolism, while walking with -40% body weight did not.

Commentary: COMP is a marker of articular cartilage metabolism. This is the first published study to show a positive association between body weight unloading on the AlterG Anti-Gravity Treadmill and reduced levels of COMP. These results suggest that AlterG exercise could be protective to articular cartilage compared to full body weight exercise.


- The study objectives were to determine the effect of a 12-week lower body positive pressure (LBPP)-supported low-load treadmill walking program on knee joint pain, function, and thigh muscle strength in overweight patients with knee osteoarthritis (OA). Participants reported significant improvements in knee joint pain and function and demonstrated significant increases in thigh muscle strength about the degenerative knee. Participants also experienced significant reductions in acute knee pain during full weight bearing treadmill walking and required dramatically less LBPP support to walk pain free on the treadmill. These findings have important implications for the development of nonoperative treatment strategies that can be used in the management of joint symptoms associated with progressive knee OA in at-risk patient populations.

Commentary: The AlterG Anti-Gravity Treadmill is particularly effective after total knee arthroplasty to reduce pain, improve exercise compliance, and improve early (first 3 postop months) function.
CLINICAL RESEARCH UPDATE

BIOMECHANICS

Gojanovic B, Shultz R, Feihl F, Matheson G.

- A 4-wk HIIT protocol at 100% vVO2max improves field performance, vVO2max, VO2max and submaximal HR in trained runners. Improvements are similar if intervals are run on a regular treadmill or at higher speeds on a LPBB treadmill with 10% body weight reduction. LBPP could provide an alternative for taxing HIIT sessions.

Commentary: This study demonstrated that elite trained runners can maintain a metabolic training effect on the AlterG Anti-Gravity Treadmill, improve running performance, and have the benefit of reduced joint loading during training to theoretically reduce injury risk to the lower extremities.

Jensen BR, Hovgaard-Hansen L, Cappelen KL.

- Unweighting with LBPP reduced estimated joint force significantly although less than proportional to the degree of weight support (ankle). It was concluded that leg muscle activation adapted to the new biomechanical environment, and the effect of unweighting on estimated knee force was more pronounced than on ankle force.

Moran MF, Rickert BJ, Greer BK.

- Peak tibial acceleration and peak-to-peak tibial acceleration was measured via a uniaxial accelerometer attached to the tibia during a 37-min continuous treadmill run that simulated reduced BW conditions. The trial began with a 10-min run at 100% BW followed by nine 3-min stages where BW was systematically reduced from 95% to 60% in 5% increments. RESULTS: There was no significant relationship between level of BW and either peak tibial acceleration or peak-to-peak tibial acceleration (p>.05). Both heart rate and step rate were significantly reduced with each 5% reduction in BW level (p<.01). CONCLUSION: Although ground reaction forces are reduced when running in reduced BW conditions on a DAP treadmill, tibial shock magnitudes are unchanged as an alteration in spatiotemporal running mechanics (e.g. reduced step rate) may nullify the unloading effect.

Commentary: Runners should aim to maintain step rate with body weight support on the AlterG Anti-Gravity Treadmill to achieve reductions in tibial shock magnitudes.

McNeill DK, de Heer HD, Bounds RG, Coast JR.

Neal M, Fleming N, Eberman L, Games K, Vaughan J.

Sainton P, Nicol C, Cabri J, Barthèlemy-Montfort J, Chavet P.

Sainton P, Nicol C, Cabri J, Barthelemy-Montfort J, Berton E, Chavet P.

Smoliga JM, Wirfel LA, Paul D, Doanberger M, Ford KR.

Thomson A, Einarsson E, Witvrouw E, Whiteley R
PHYSIOLOGY


- This study aimed to develop a user-friendly conversion table showing the speeds required on an LBPP treadmill to match the equivalent metabolic output on a regular, non-LBPP treadmill across a range of body weight supports. A total of 20 recreational runners (11 males, 9 females) ran multiple 3-minute intervals on a regular treadmill and then on an LBPP treadmill at 6 different BWs (50–100%, 10% increments). Metabolic outputs were recorded and matched between the regular and LBPP treadmill sessions. Using regression analyses, a conversion table was successfully created for the speeds from 6.4 to 16.1 km·h⁻¹ (4 to 10 mph) in 0.8 km·h⁻¹ (0.5 mph) increments on the regular treadmill and BW proportions of 50, 60, 70, 80, 90, and 100% on an LBPP treadmill. The table showed that a greater increase in speed on the LBPP treadmill was needed with more support (p < 0.001) but that the proportion increase was smaller at higher speeds (p < 0.001).

Commentary: This is an interesting study demonstrating that increased treadmill speed can compensate for the reduced metabolic load for runners wishing to maintain metabolic load on the AlterG Anti-Gravity Treadmill. The study did not factor treadmill incline, which can also be used to increase metabolic loads with body weight support.


- This study evaluated how body weight support influenced the relationship between velocity and metabolic cost among 6 elite male distance runners. With increasing amounts of body weight-support (BWS), the slope of the relationship between velocity and oxygen consumption (ΔVO2/Δv) decreases significantly. This means the change in oxygen consumption (VO2) is significantly smaller over a given change in velocity at higher amounts of BWS. There is a non-linear decrease in VO2 with increasing BWS. As such, with each increment in the amount of BWS provided, the reduction in VO2 becomes increasingly smaller. This paper provides first of its kind data on the effects of BWS on the cost of running among highly trained, elite runners. The outcomes of this study are in line with previous findings among non-elite runners.


NEUROLOGY: STROKE REHABILITATION


- Body-weight-supported treadmill training has been shown to be an effective intervention to improve walking characteristics for individuals who have experienced a stroke. Following training, self-selected gait speed increased from 0.50 m/s to 0.96 m/s, as measured by the 10-meter walk test. Stride length increased from 0.58 m to 0.95 m after training and to 1.00 m at 1-month follow-up. Peak hip flexion increased from 3.7° to 24.6° after training and to 19.4° at 1-month follow-up. Peak knee flexion increased from 19.4° to 34.3° after training and to 42.7° at 1-month follow-up. Measures of endurance, fall risk, and percentage of perceived recovery also were found to improve posttraining.

Commentary: There is considerable variability in functional status for individuals post acute or chronic stroke. The AlterG Anti-Gravity Treadmill has gained wide acceptance amongst neurologic therapists for its ability to allow ambulatory exercise in a secure fall-safe environment.

GENERAL REHABILITATION


- Breast Cancer survivors can experience a myriad of physical and psychological benefits as a result of regular exercise. This study aimed to build on previous research using lower impact exercise programs by using an antigravity (Alter-G®) treadmill to administer cardiovascular training. The results of this study suggest that the use of a physical activity program in combination with an Alter-G® treadmill may provide practical and meaningful improvements in measures of cardiovascular endurance and body composition.

Commentary: The AlterG Anti-Gravity Treadmill can be used as an enabler of exercise in multiple clinical rehabilitative situations.